Ref #	Approach	Strategic Management Action
1	Dynamic Management	Add sediment to sediment-starved estuaries and wetlands to help keep pace with sea level rise.
2	Dynamic Management	In areas dominated by grey infrastructure, identify potential demonstration sites for green infrastructure projects and/or other "active management" projects; implement and evaluate effectiveness to inform future efforts across the region. Potential project options include: - Use wastewater treatment plants to supply water for drying estuaries - Build a horizontal levee in threatened part of sanctuary (e.g., estuary that is flood-prone or needs additional habitat) - Install bioswales near areas dominated by infrastructure/roads - Install rain gardens with soil layers engineered to help stormwater infiltrate underlying layers of soil - Install box culverts under roads to allow larger passage for high flow events
3	Dynamic Management	Reduce armoring that exacerbates erosion; replace with natural material to create sloped, transitional habitat (e.g., artificial reef or dune). If armoring can't be removed, implement living shoreline techniques in conjunction with new construction/repairs.
4	Dynamic Management	Let go of pocket beaches that can’t retreat, and do not intervene with management actions.

5	Dynamic Management	For sediment-heavy estuaries, conduct instream and upstream restoration work to reduce sediment delivery and flash floods. Activities could include: - restore impaired and incised creeks - add large woody debris - reconnect creeks to floodplain - restore incised creeks by raising elevation to allow overflows/sediment deposition - dechannelize upstream segments - restore stream complexity - remove old road crossings and sediment sources - plant vegetation (e.g., drought/heat tolerant native species) - incentivize best land management practices that enhance soil health and decrease runoff and erosion (e.g., rotate land uses on agricultural upland properties, plant drought-tolerant natives, forest management) - build retention ponds/catchments that can be used for upland water management opportunities **For all activities listed, note that environmental conditions (e.g. storms, flooding, erosion, drought, SLR) can shift estuaries between sediment-starved and sediment-heavy, so this action will need to be dynamic and respond to changing estuary conditions in the future.
6	Dynamic Management	Encourage a climate-smart response to erosion events that smother the rocky intertidal by developing a diagnostic decision support tool so management agencies know how to respond to either 1) recover the habitat by removing material, 2) leave material and encourage surfgrass growth or 3) leave material and take the opportunity for creation of a new beach. Have at the ready the knowledge to take advantage of the new situation due to erosion events. Ideally would have some options with the ultimate goal of leveraging resources to provide the best response.
7	Dynamic Management	Maintain streamflow to mitigate estuarine temperature increases and salinity changes. Activities to help maintain streamflow could include: - upland water management (e.g., implement best management practices) - dam releases - upland restoration - building and using water retention ponds (land owners draw water from ponds rather than stream)

8	Education	Enhance education programs (including marsh and tidepool education and interpretation programs) through training and guidance to communicate the implications of climate change and the exacerbating stressor of trampling and recreation on coastal habitats. Target existing programs (e.g. Duxbury and Fitzgerald Marine Reserves) and identify other highly-visited areas that need attention from volunteer docents. Docents should all have a common training core that includes climate change impacts and the exacerbating stressor of trampling and recreation on intertidal habitats, as well as tidepool etiquette and safety and the impact that impaired safety will have on natural resources. (i.e. boat groundings and the impact of emergency response). Strategies could include SLR visualizations and clean-ups.
9	Habitat Protection and Restoration	Remove or modify structures that disrupt the delivery of sediment via long-shore sediment transport (jetties, breakwaters, storm and wastewater discharge pipes), and coastal and near-shore structures that contribute to erosion. Prioritize areas that are already impacted by these structures, and remove where possible. If the structure cannot be removed, then enable for managed retreat (for bluffs to feed the beach as sea level rises) and support beach nourishment to allow for beach expansion.
10	Habitat Protection and Restoration	Create local and regional sediment management plans for full range of the sanctuary that are climate informed.
11	Habitat Protection and Restoration	Restrict and direct human access on cliff base, face and top; including motorized transport.

12	Habitat Protection and Restoration	Monitor dredge materials to be used for beach restoration or expansion for contaminants, make sure existing regulatory mechanisms control for contaminant exposure and take into account interaction with additoinal stresses form climate change (e.g. temperature, dilution concentrations, pH)
13	Habitat Protection and Restoration	In the aftermath of a spill of oil or other contaminant, ensure that restoration of affected areas takes into account climate considerations (type of restoration, location of restoration, what should actually be restored based on climate envelope modeling to predict what species will likely become dominant). Oil spill restoration plans need to explicitly account for climate impacts on restoration of affected sites.
14	Habitat Protection and Restoration	Identify and purchase additional cliff lands that are less likely to erode and will therefore provide enduring cliff habitat
15	Habitat Protection and Restoration	Stabilize cliffs through revegetation (with climate appropriate species) and natural netting (e.g. jute, not chainlink fence).
16	Habitat Protection and Restoration	In restoration projects, use drought tolerant and heat resistant species or strains that fullfill ecological function of beach and dune processes.
18	Habitat Protection and Restoration	Construct/augment coastal dunes. Remove/relocate shoreward constraints to dune movement and evolutions.
19	Habitat Protection and Restoration	Protect beaches in order to protect cliffs (see beach strategies).
20	Human Disturbance	Restrict human access to critical rocky intertidal areas. The type of access to rocky intertidal ecosystems that seemed appropriate in the 1960s may not be as appropriate now based on current knowledge of the increasing impact of people on these changing and likely more fragile ecosystems.

21	Human Disturbance	With the expectation that climate change impacts (such as those from storm activity and sea level rise) will reduce or cause major marine mammal haul-outs and seabird nesting sites to change, monitor and identify new locations of major marine mammal haul-outs and seabird nesting sites (see strategy 46) and provide protections for those locations. Reduce human disturbance, especially during times of heavy surf and inundation that will reduce availability of these habitats. Protect from major sources of disturbance from land, air and sea when appropriate, either as Special Closures, low overflight prohibition zones or land-based closures. For example, NPS creates seasonal closure depending on the location of new elephant seal colonies and exposure to storm surf.
22	Human Disturbance	Minimize access through dunes to protect dune stability.
23	Invasive Species Management	Prevent non-native invasive species establishment in estuaries. Potential activities to prevent establishment include: - plant natives (e.g., in disturbed areas) - remove invasive species that are near/adjacent to estuaries that have the potential to invade (e.g., invasive tunicate, green crabs).
24	Invasive Species Management	Update the definition of introduced species for Sanctuary management: if it is a California Current species, it should be managed as a native, and expansions into the study area should be considered a migration or expansion. If it is foreign to the California Current ecosystem, it should be managed as an invasive (and efforts made to remove). Take into consideration the definition provided by the National Aquatic Nuisance Species Task Force.
25	Invasive Species Management	Enhance the detection and monitoring of species changes (southern species moving north, northern species moving out and invasive species moving in) via a novel rapid assessment program. Something similar to Reef Check, partner with PISCO and MARINe (currently monitoring sites two times per year, needs to be more frequent and in more locations). Engage land managers (such as PRNS, CDFW, Sanctuary via LiMPETS) to leverage pre-existing efforts to detect and monitor. Create a uniformity of practice across the region.

26	Invasive Species Management	Rapid response of non-native invasive species removal following detection to protect natural systems (e.g., control invasives via: manual removal, flooding, fire in transition zones; restablish natives).
27	Invasive Species Management	Remove non-native invasive plants (jubata grass) that undermine cliff integrity, and where approporiate, replant with natives or drought-/heat- tolerant species that support cliff structure.
28	Landward Migration	Remove/redesign roads in locations that act as barriers to natural expansion of habitats. Prioritize roads that are already impacted by high tides and start with those immediately. Always remove roads where possible; if not possible, redesign the road. Steps to accomlish this action in a changing climate include: 1) Identify areas that: A) are critical for estuary expansion and that have roads that impede estuary migration, and B) have roads vulnerable to sea level rise, flooding, other climate impacts 2) Develop Rapid Climate-Ready Response plans: develop plans that will allow for road removal/redesign in case of a disaster (e.g., road is wiped out in a flood) 3a) Post-disaster (flooding/road failure): implement the Rapid Climate-Ready Response plan to move/redesign road to a enhance future resilience 3b) If road is not impacted by climate change/extreme events, remove/redesign the road as available during standard maintenace schedule timeframes (i.e., when the opportunity arises to replace/redesign the road, take it)

29	Landward Migration	For roads that can't be raised/moved, or in conjunction with raising/moving roads, look for opportunities to create functional habitat (e.g., replace hard/grey infrastructure such as rip-rap with living shorelines and migration space)
30	Landward Migration	For locations identifed as having coastal area available for developing new rocky intertidal habitat (see strategy 46), provide further protection by relocating human infrastructure and allow cliffs to erode to create new habitat. Do not allow the creation of seawalls that would inhibit cliff erosion.
31	Landward Migration	Waiving of rights to future sea walls in permits or encouraging waiving of rights for shoreline habitat protection in exchange for something analogous to an agricultural tax credit (e.g. coastal protection tax credit)
32	Landward Migration	Allow for landward migration by purchasing additional cliff lands and land behinds cliffs.
33	Landward Migration	Exclude development in critical estuary areas and areas of potential estuary expansion through various policy changes. Exclusion language should be integrated into policies for retrofiting exisiting buildings, new construction, and rebuilding post-disaster. Add sea level rise conditions to general plans and local coastal plan updates.
34	Landward Migration	Prioritize locations, purchase or redesignate inland land for inland movement of beach and dune habitat: including use of Open Space/Conservation Easements
35	Landward Migration	Move utilitly infrastructure (e.g., power lines, sewer pipes) that blocks or impedes estuary migration, or presents a potential risk of contamination of estuary.
36	Landward Migration	Require deed disclosure of permit conditions for habitat protection or restrictive development conditions reflective of changing coastal conditions.

37	Landward Migration	Work with counties to zone for protection of dunes and cliffs (setbacks, buffers, moratoria, elevate structures, designate areas of special biological interst for protection) to reflect changing coastal conditions
38	Landward Migration	Re-evaluation of property for development in locations where natural disaster has destroyed previous structure
39	Landward Migration	Remove seawalls (including rip rap) and make associated modifications to support retreat.
40	Landward Migration	Move or modify visitor facilities/pavement, including parking
41	Legal Impediments	Change definition of Mean Higher High Water; or Use a Rolling Tidal Epoch to capture effects of SLR on location of public trust boundary. The elevation of mean high water is estimated using tide gauge data over an 18.6 year tidal epoch. The present tidal epoch is from 1983 through 2001 and is actively considered for revision every 20-25 years. As sea levels rise, the line demarcating public tidelands will move landward. Allowing for a rolling tidal epoch means the mean high water could be based on more current data and provide information on the movement of the boundary of public trust lands as sea levels rise.
42	Legal Impediments	Confirm definition of “existing structures” and adjust “shall allow armoring” language in LCP updates and section 30235 of Coastal Act, in order to limit vulnerable coastal development and protect the public trust as it moves inland with sea level rise

43	Science Needs	Conduct regional inventory and modeling to identify how existing estuaries may change and identify potential areas for estuary expansion; use this information to set regional adaptation priorities. This effort includes: - completing current estuary inventory - identifying values of different estuaries (e.g., estuary harbors endangered species [or those that may become so], has valuable wilderness character, soundscapes, landscapes, lightscapes, pinniped breeding sites and haulouts, salmon habitat, etc.] - identifying where future estuary habitat may move - better understanding how habitat types may change, and - better understanding and modeling system dynamics, and how they may change (e.g., how tidal prism may change) If possible: - Model entire region, utilizing current information/regional efforts and modeled future changes to identify net changes to estuaries - If not, model specific sites of management interest - If really limited, look only at the information we currently have (e.g., OCOF model) rather than conducting new modeling
44	Science Needs	Capitalize on opportunities to increase monitoring and knowledge of estuary processes and climate change impacts to inform adaptive management (e.g., monitor impacts of projected El Nino, study closed/open estuaries)
45	Science Needs	Determine the source of sediment for vulnerable beaches in order to improve sediment supply processes.

46	Science Needs	Identify future viable locations for rocky intertidal habitat migration inland either through modeling or known information (how do rocky intertidal areas form, and would there be available rock inland for habitat migration? Is there rock under the cliff bluffs or under the sand?). Identify future viable locations for seabird and marine mammal breeding sites and haul-outs.
47	Species Protection	Designate, expand, and increase enforcement of resource management areas/sensitive habitat/off limit zones to enhance and support special protections for target species.
48	Water Quality Management	Improve storm water management by reducing combined sewer overflow events.
49	Water Quality Management	Capture and redirect storm water away from cliff face into better infiltration systems to reduce erosion and avoid landslides.
50	Water Quality Management	To prevent algal blooms, Regional Water Quality Control Boards that manage TMDLs for nutrients should consider stricter prohibitions for effluent flows of excessive fertilizer to address stressors of excessive nutrients at low flow times into the ocean, a situation likely to get worse with climate change. See publication: http://pubs.acs.org/doi/pdf/10.1021/acs.est.5b00909.
51	Water Quality Management	Take a watershed approach for rocky intertidal areas near estuary mouths, streams, etc. to limit sediment and improve water quality entering from the watershed: 1) Watershed managers and regional water quality control boards should enforce TMDLs with forestry operations, municipalities, agriculture, etc. to limit sediment coming down into the intertidal area. 2) Incorporate climate considerations into formulation of TMDLs in specific locations (see site specific category) to respond to predicted climate change impacts on outflows of sediment, toxins and nutrients.

52	Water Quality Management	Improve storm water management by creating bioswales and other urban run-off reduction tools (e.g. permeable pavement, street trees/catchment/storage).
53	Water Quality Management	Improve storm water management by reducing agricultural (croplands and livestock) run-off (buffer strips).
54	Alleviate Climate Impacts	Restore and enhance lower intertidal mussel beds and algae, including sea palms (a species identified as vulnerable), to buffer from storm activity by enhancing structural roughness (physical/structural resistance) to lessen impacts of storms on intertidal zones.
55	Alleviate Climate Impacts	Restore subtidal kelp forests to attenuate waves and buffer from enhanced storm activity.
56	Alleviate Climate Impacts	Restore and enhance surfgrass *(Phyllospadix)* and algal species to act as aqueous canopies and provide shading to reduce temperatures and reduce evaporation in tide pools.
57	Alleviate Climate Impacts	Diminish heat stress by testing the efficacy of shade delivery systems (including nest umbrellas/boxes/tents and revegetation) or encouraging animals to nest in more protected areas.

58	Dynamic Management	Manage the bar: - create a breach if estuary closes and conditions are detrimental to estuarine species or resources of interest - actively close the bar if estuary is open and conditions are detrimental to estuarine species or resources of interest
59	Dynamic Management	Reconsider sediment requirements and stream management mandates to ensure sustainable sediment delivery to estuaries. Activities could include: - conduct sediment study for each estuary site to determine if estuary is sediment-starved or keeping pace with sea level rise - reconsider stream sediment TMDLs in light of estuary sediment needs - create a climate-informed sediment management plan
60	Habitat Protection and Restoration	Protect and promote eelgrass growth; protect existing beds and restore areas that have been destroyed by moorings or other infrastructure.
61	Habitat Protection and Restoration	Remove overgrowth of macroalgae (ulva blooms) from rocky intertidal habitat as they occur.
62	Habitat Protection and Restoration	Stabilize cliffs with hardening methods that are designed for ecosystem protection, not infrastructure or property protection.

63	Habitat Protection and Restoration	Beach nourishment
64	Habitat Protection and Restoration	Install sediment traps (add good jetties, giant fine mesh nets, sand flume cells) to accumulate sediment where needed.
65	Habitat Protection and Restoration	Restrict livestock access to cliff top, including rotational grazing plans.
66	Habitat Protection and Restoration	Evaluate and remove or modify barriers to riverine flow and sediment supply (dams, bridges, culverts, and flood-control gates) to allow for greater sediment transport to beaches and estuaries.
67	Habitat Protection and Restoration	Engineer marshlands to enhance water flow and balance sediment transport. Activities could include sinuous channelization.
68	Habitat Protection and Restoration	If a barrier is required to protect human infrastructure, determine the most beneficial material to use and the best design to encourage rocky intertidal species to colonize and/or migrate landward. This is not a recommendation to create new barriers, and should only be implemented where totally necessary and already planned, or the barrier is already in place and opportunities exist to refashion the barrier / infrastructure in a way that promotes a simultaneous habitat use with the barrier.
69	Habitat Protection and Restoration	Protect cliffs from erosion to protect rocky intertidal habitat from smothering (see cliff protection strategies).
70	Human Disturbance	Prepare for increased beach use in the event that climate change results in dryer, sunnier weather, including managing traffic, litter, visitor services, etc.

71	Human Disturbance	Manage pet beach experience/access (leashes, locations)
72	Human Disturbance	Manage or control density and distribution of beach users through beach lottery tags/beach reservations if beaches become too impacted by high visitation.
73	Landward Migration	Require bond payment by landowners for future removal of infrastructure on current and future beach/dune/cliff properties
74	Landward Migration	Provide incentives for human relocation in areas that were, or could be, estuary habitat, or where development reduces estuary resilience: - Incentivize managed retreat if space is available - Initiate and practice land trading (e.g., trade less valuable park land for private land that is vulnerable to flooding and that currently blocks estuary migration) - Purchase land, when possible, to faciliate estuary migration
75	Landward Migration	Removal of blocking infrastructure - buildings, roads, or agricultural endeavors
76	Landward Migration	Create a Transfer of Development Rights program in areas needing protection to reflect changing coastal conditions. In hazard areas or sensitive habitat areas that will be threatened by SLR over time, transfer development rights from vacant lots not suitable for development to other locations in the jurisdiction
77	Landward Migration	Rolling easements
78	Science Needs	Promote estuarine research to enhance eelgrasss restoration efforts. Major research questions may include: - Eelgrass distribution: why is there no eelgrass in Bolinas and Pescadero? - Do salinity and turbidity affect eelgrass establishment and persistence?
79	Science Needs	Pursue and encourage research in OA-mitigation methods including the restoration and expansion of photosynthesizers (kelp, surfgrass) to locally mitigate the impacts of OA and sequester carbon (see references in appendix). Sanctuary should seek partnerships with technical experts who wish to establish experimental treatment plots to test these mitigation techniques.

80	Science Needs	Better understand larval dispersal to ensure that larval source locations are effectively protected within the MPA system and are able to reach various intertidal areas (inside and outside MPAs). Investigate larval dispersal of key species and how this relates to distances among MPAs. Also consider important areas that are not currently designated MPAs.
81	Species Protection	Augment haul-out and nesting sites: floating haul outs, larger buoys, artificial offshore structures
82	Species Protection	Support animal rescue and rehabilitation services.
83	Species Protection	Incorporate climate change into fisheries management, including the use of regulations and harvest limits to address the impact of ocean acidification and climate stressors. Reduce human harvest (non-climate stressor) of OA-impacted species when needed. Exact strategy would depend on how specific species are being impacted. Monitoring to track impacts and effectiveness of regulations will be needed.
84	Water Quality Management	Manage for flash flood and high flow events that might adversely affect existing and new vegetation by increasing absorption and decreasing runoff. Strategies may include: improve culverts, pumps, tide gates, bridges, stream management, increased use of permeable pavement and increased absorption opportunity, all communities require rain barrels.
	Habitat Protection and Restoration	Restore and/or create high marsh/upland transitional vegetation, wetland habitat, and deltas in areas that are flood-prone for multiple purposes: to accommodate landward marsh migration, to provide refuge habitat for marsh species during high tide events, and to provide flood protection

Spatial or site-specific details	Timeframe	Stressor(s) addressed
Sediment-starved estuaries, or where needed. Potential location: Tomales Bay	Near-term	sea level rise, sediment supply
Site-specific: location and method/project will be determined by issues in each specific estuary Prioritize estuaries currently impacted by flooding/storms, and in locations where the project could have co-benefits for other systems or human communities	Near-term	precipitation, sea level rise, coastal erosion, wave action
Potential locations: Bolinas Lagoon (on lagoon side of the spit), Seadrift on Stinson Beach, Tomales Bay, Sonoma County along Hwy 1, Russian River	Mid-term	overwater/underwater structures, roads/armoring, coastal erosion
Those that can't be nourished or retreat: Sea Ranch, along Sonoma Coast, on Farallon Islands, GGNRA in SF and Marin, PRNS.	Long-term	coastal erosion, sea level rise

Potential locations: Pescadero Marsh, Bolinas Lagoon, San Gregorio, Tomales Bay, Drakes Estero.	Near-term	sediment supply, turbidity, land use change
There are proximal (cliff failure) and more distant (debris flow from coastal watersheds) sources of sediment - to address more distant sources, perhaps focus on the largest coastal watersheds (including Garcia, Gualala and Russian Rivers, Pescadero and Gazos Creeks) with soils, topography, etc. that are likeliest to yield the greatest amount of debris flows. To address more proximal causes (cliff failure), identify intertidal areas that are particularly vulnerable.	Near-term	coastal erosion, wave action, precipitation
Smaller estuaries and estuaries with closed bars. Potential location: Esteros de San Antonio and Americano.	Near-term (as needed)	temperature, mixing/stratification, precipitation, oxygen, pH, salinity

Highly visited beaches, estuaries and tidepools.	Near-term	recreation/tramplin g
Potential locations: Pillar Point jetty which disrupts the delivery of sediment to surfer's beach in Half Moon Bay, bulkheads along the lagoon side of Seadrift that impact sediment deivery to Bolinas, Oceanside Water Pollution Control Plant (including the westside transport box and Lake Merced Tunnel) and the Great Highway that impact Ocean Beach in San Francisco, structures that impact Fort Funston. Narrow road culvert at Schooner Bay, Drakes Estero.	Mid-term	coastal erosion, sediment supply and movement, wave action, wind, precipitation, overwater/underwa ter structures, sea level rise
Exist: S. Monterey Bay, Santa Cruz, San Francisco (littoral cell internal draft is under review); still needed for: Marin, Sonoma, S. San Mateo County, San Francisco (central bay)	Immediate	coastal erosion, sediment supply and movement, wave action, wind
Gleason's beach, Devil's slide (though this impact may be ameliorated by the tunnel), Jenner, Bolinas.	Immediate	coastal erosion, sea level rise, wave action, recreation, road/armoring

Region-wide	Immediate	dredging
	Near-term	pollution (oil spills)
	Near-term	coastal erosion, sea level rise, land use change
Places experiencing vegetation loss through social trails or other means (social trails are paths not created by the land manager, but created by people walking repeatedly through a particular area to create a worn path)	Near-term	coastal erosion, sea level rise, wave action
Any location where restoration is proposed.	Near to mid-term	invasive and problematic species, air temperature
Many coastal locations (e.g. Stinson Beach, North and South beach of PRNS).	Mid to long-term	coastal erosion, wave action, sediment supply and movement
		coastal erosion, sea level rise, wave action
Critical habitat in the study region that deserves protection from human impact: important larval source, highly visited, highly impacted.	Near-term	recreation/tramplin g

Historical areas - Pescadero Rocks, Bean Hollow, etc. Proritize the locations with the largest amount of disturbance to the largest breeding sites. Fitzgerald Marine Reserve already has this protection (cones are put out when mammals are present, and rangers are present), Pillar Point haulout has no protection. Spatially identify where these sites are and if there are new areas that will need protection due to SLR if used by marine mammals.	Near-term onward	wave action, recreation/tramplin g
Highly visited beaches that require access through dunes.	Near-term	coastal erosion, sea level rise, wave action, recreation
Region-wide	Near-term	invasive & other problematic species, sediment supply
Throughout study region.	Near-term	invasive & other problematic species, sediment supply
Existing MARINe sites (especially those that are less disturbed), urban/more disturbed sites like Fitzgerald and Duxbury where volunteers and visitors can be engaged.	Near-term	invasive & other problematic species, sediment supply

Region-wide with focus on National Parks (GGNRA, PRNS), State Parks, and private lands	Near-term	invasive & other problematic species
Cliff habitat throughout study region.	Near-term	invasive & other problematic species
Potential project locations: 1) Highway 1 along the east shore of Tomales Bay 2) North end of the Bolinas "Y" 3) Highway 1 at Pescadero Marsh 4) Sir Francis Drake Blvd near Drakes Estero (re-route or re-design) 5) Pescadero Creek Road 6) Highway 1 at Surfer's Beach in Half Moon Bay 7) Highway 1 at Gleason Beach 8) Great Highway at Ocean Beach in San Francisco 9) Dillon Beach to Lawson's Landing	1) Long-term 2) Near-term (higher urgency) 3) Long-term 4) Near-term (higher urgency) 5) Near-term: assessment; Long-term: implementation 6) - 9) Mid to long-term	sea level rise, roads/armoring

Region-wide Potential location: install a horizontal levee at Bolinas Lagoon/Hwy 1	Bolinas Lagoon: Mid-term Region-wide: long-term, leverage opportunities when they exist	sea level rise, overwater/underwater structures, roads/armoring
Create unfettered sea-to-land linkages for new habitat development. Where possible maintain the thread-like habitat continuity of rocky intertidal habitat north to south - avoid where possible large stretches of total inundation of rocky intertidal habitat. If design is possible, create new habitats that are less powerfully affected by storm damage, i.e., is there "wiggle room" to design new habitats that will be resilient to increasing storm surges.	Long-term	sea level rise
	Near-term	coastal erosion, sea level rise, wave action, roads/armoring
	Near-term	coastal erosion, land use change
	Near-term	sea level rise, coastal erosion
Any site that is vulnerable to SLR and has potential to move inland.	Near to long-term	coastal erosion, sea level rise, wave action
Will likely be similar locations as road removal/redesign All projects involving Hwy 1	Near-term and long-term	sea level rise, overwater/underwater structures
	Mid-term	coastal erosion, sea level rise, wave action

	Mid-term	coastal erosion, sea level rise, wave action, roads/armoring
	Mid to long-term	coastal erosion, sea level rise, wave action
Surfer's Beach, Sea Drift, parking lots at Drakes Beach, North and South beach at PRNS.	Mid to long-term	coastal erosion, sea level rise, roads/armoring
Visitor facilities (visitor centers, kiosks, bathrooms, singage, trails and parking lots)	Depends upon timing of impact	coastal erosion, sea level rise, roads/armoring
Throughout study region	Near to mid-term	sea level rise
Throughout study region	Near to mid-term	sea level rise

Study region	Immediate	sea level rise, precipitation, overwater/underwater structures, roads/armoring, coastal erosion
Study region	Near-term	precipiation, wave action, coastal erosion, turbidity, salinity, sea level rise, pH
Whereever sediment patterns are vulnerable and uncertain	Near to mid-term	coastal erosion, sediment supply and movement, wave action, wind

TBD through modeling analyses and site analyses. Some modeling has been done at PRNS for elephant seals.	Long-term	sea level rise
Study region	Near-term	coastal erosion, sea level rise, temperature, precipitation
Ocean Beach, Fort Funston, Pacifica, other locations with combined sewer overflow	Near-term	precipitation, coastal erosion
	Near-term	pollution, precipitation
San Francisco Bay (Napa and Sonoma rivers have TMDLs for nutrients which are now under consideration for delisting), Walker Creek and Tomales Bay (mercury and pathogens only, not nutrients), and Russian (phosphorus in the Laguna de Santa Rosa) rivers all have water quality impairments for nutrients. TMDLs are under development for Fitzgerald Marine Reserve (for bacteria) and for Pescadero Marsh/Butano Creek (sediment).	Near-term (higher urgency)	pollution, oxygen, stratification
Potential project locations: 1) Garcia River estuary next to Point Arena intertidal reefs. Farmland and forestry operations upstream. 2) Gualala River next to Gualala Point. Logging and land recently purchased as conservation lands. 3) Russian River with rocky intertidal both north and south of estuary mouth. Mercury-rich sediments from mines upstream. Forthcoming inclusion of Lake Mendocino and Lake Sonoma in the Statewide Reservoir Mercury TMDL. 4) Pescadero Creek with rocky intertidal area just south of estuary. 5) Gazos Creek with Ano Nuevo just south. Timber logging upstream.	Near-term	coastal erosion, precipitation, land use change

Pacifica/Linda Mar Beach, San Francisco, Half Moon Bay and other San Mateo County Unicorporated Areas, all highway locations in the five county area	Near to mid-term	precipitation, coastal erosion
San Mateo County, Lawson's Landing, Sonoma County, Tomales Bay	Near to mid-term	precipitation, sediment supply and movement
Consider the evolving (new) subtidal and intertidal zones	Near-term onward	wave action
Select locations that do not currently have kelp but have appropriate conditions for kelp settlement and growth (good light and water quality, little turbidity).	Near-term onward	wave action, coastal erosion
Prioritize intertidal reefs that are most vulnerable to prolonged exposure and heat stress. Potential locations include: Tomales Bay headwaters, Point Reyes Headland, Palomarin, Pescadero State Beach, San Gregrorio State Beach, Fitzgerald Marine Reserve, Año Nuevo State Park, Pigeon Point, and Pillar Point for *Phyllospadix scouleri* , and Moss Beach for *P. torreyi* (see calflora.org for more information on species distributions).	Long-term	air temperature, sea surface temperature, salinity
Farallon Islands, critical nesting sites	Near-term	temperature, precipitation

Site specific: will largely depend on estuary condition (e.g., breach may be required in case of restricted passage or poor water quality; closure may be required to capture necessary freshwater outflow or to protect from marine pollutants) Potential areas for breach: Bolinas Lagoon (although natural closure may be unlikely with sea level rise), Pescadero Marsh, Russian River, Muir Beach, San Gregorio, Tunitas Creek, Pomponio, Rodeo Lagoon, Gazos Creek, steelhead or salmon bearing streams that have restricted passage Potential areas for closure: Nursery grounds (e.g., Russian River - salmon), or in case of pollutants (e.g., done at Rodeo Lagoon in the past to protect from oil spill)	As conditions require.	precipitation, oxygen, pH, water temperature, salinity, turbidity, currents/mixing/stratification, temperature
Region-wide, but prioritize sediment-starved estuaries. Potential location: Tomales Bay	Near-term	sediment supply, coastal erosion, sea level rise
Potential locations: Tomales Bay, Esteros de San Antonio and Americano	Immediate	pH, overwater/underwater structures, temperature
Areas impacted by major overgrowth.	Immediate	pollution, oxygen
Critical sites for cliff-nesting birds.	Near to mid-term	coastal erosion, sea level rise, wave action, extreme weather

Potential locations: Ocean Beach: middle and southern reaches, Stinson Beach, Inverness, East Shore, Dillon Beach, Lawson's Landing, Salmon Creek, Jenner, Half Moon Bay, Surfer's Beach, pocket beaches on Farallon Islands, Point Arena, Manchester State Park, Gualala Point Regional Park, other locations as identified in the draft San Francisco Regional Sediment Management Plan	Near to mid-term	coastal erosion, sediment supply and movement, wave action, wind
Cliff-backed beaches, pocket beaches, high erosion beaches.	Long-term or emergency measure	coastal erosion, sediment supply and movement, wave action, wind
Hwy 1 north of Jenner; Sonoma and Marin Counties	Immediate	coastal erosion, sea level rise, land use change
Throughout region, including dams on rivers draining to SF Bay, water district dams - Lagunitis Creek, Russian River, Gualala, Walker Creek. Focus upstream of sediment-starved estuaries and beaches.	Near to long-term	sediment supply and movement, precipitation, overwater/underwater structures, sea level rise, coastal erosion
Apply to restoration projects; flood-prone estuaries; sediment-heavy estuaries; archaeological sites/past development sites (i.e., where erosion may be an issue)	Long-term	sediment supply, sea level rise, oxygen, temperature
Only in locations where a barrier is necessary and already planned.	Long-term	armoring, coastal erosion, wave action, sea level rise
throughout region	Near-term	recreation, temperature, coastal erosion, sea level rise

Known haul out, nesting and restoration sites, shorebird wintering sites	Near-term	recreation, temperature, coastal erosion
Highly visited beaches.	Near-term	recreation, temperature, coastal erosion, sea level rise
	Near-term	coastal erosion, sea level rise, wave action
Areas where hydrology is impaired, estuary can't migrate, infrastructure is projected to be innundated anyway, and/or areas where barrier removal would improve wetland/estuary function or resilience.	Near-term: land acquistion Long-term: land trading, but start laying policy foundation now	sea level rise, coastal erosion, precipitation
Places where lifetime of structure is ending or structure is creating coastal hazard	Near to long-term	coastal erosion, sea level rise
	Mid-term	coastal erosion, sea level rise, wave action
	Mid to long-term	coastal erosion, sea level rise, wave action, roads/armoring
Study region	Near-term	salinity, turbidity, pH, temperature
Establish experimental treatment plots that test the effectiveness of management measures based on scientific expertise	Near-term	pH

All MPAs in the study region and additional important rocky intertidal areas.	Near-term	currents/mixing
Study region	Near to mid-term	coastal erosion, sea level rise
Study region	Near-term	temperature, precipitation
Extend protection from harvest in the rocky intertidal to the mean high-tide line next to marine protected areas (state and fed) where feasible. Maintain seamless consistency in degree of protection/mgmt.	Near-term – actions already in place	pH, harvest
Locations prone to flooding: Stinson Beach, Muir Beach, Lagunitas Creek, Hwy 1 in many locations	Near to mid-term	precipitation, coastal erosion
Undeveloped upland areas adjacent to marshes and floodprone areas adjacent to estuaries, including Bolinas Lagoon north end and east side drainages.	Near-term: acquire habitat Long-term: restoration activity	temperature, sea level rise

Key Partners	Required Resources
Sanctuary in partnership with Army Corps of Engineers and other sediment suppliers.	May be able to use dredge materials. Incorporate into a larger, watershed-specific sediment management strategy. CCC permit or federal consistency review.
Sanctuary, other estuary managers (NPS, CDFW) in partnership with universities.	Funding required for initial project implementation as well as monitoring after implementation - consider NSF and foundations. Monitoring framework. CCC permit or federal consistency review.
Estuary management agency in partnership with Sanctuary and community.	Education and outreach, CCC permit or federal consistency review.
CCC (LCP plan approval), Sanctuary, NPS	Public outreach will be required to explain inaction.

Land owners (NRCS, Resource Conservation District, local cities and counties), SWRCB (TMDL info), Coastal Conservancy, upland managers	Site-specific research to avoid invasive species introduction (vegetation management, impact assesssments). Education and outreach will be needed to gain public buy-in, as footprint to restore the floodplain may be large, and may endanger houses and infrastructure. CCC permit or federal consistency review.
USGS	Requires modeling done by USGS scientists.
Regulatory agencies, CDFW, Resource Conservation District, NPS, land owners, local water supply and flood control agencies	Education/outreach: communicate how water use impacts estuary function and other habitats; Collaboration: can potentially coordinate with/build off regulation of instream flows. CCC permit or federal consistency review.

Sanctuary as the lead, in partnership with California Academy of Sciences, local cities and counties, NPS visitor center, Marine Mammal Center, Headlands Institute, State Parks, education programs and schools.	Existing docent programs. Funding and staff required to produce materials, curricula and trainings.
Structure removal - Army Corps of Engineers, San Mateo County Harbor District, CCC, Sanctuary; Managed retreat - Caltrans, City of Half Moon Bay, CCC; Beach nourishment - Sanctuary, MBNMS, CCC, Army Corps of Engineers, SFPUC, Daly City, other local governments, Surfrider Foundation, Coastal Sediment Management Workgroup, Ocean Beach Master Plan, NPS.	Army Corps of Engineers staff, time and funds; CCC permit; political and local will. Living shorelines may need to be used to replace artificial structures and may require regulatory oversight through restoration - also may not be feasible on exposed outer coast beaches. Specific to the Pillar Point jetty: a feasibility study is near completion, and environmental impact review will be required regardless of the final action (though beach nourishment may only need an assessment). The MBNMS management plan may ned to be updated for longer term beach nourishment. A living shoreline to replace structure removal may require regulatory oversight through restoration.
Army Corps of Engineers, Coastal Sediment Management Workgroup, State Parks, BCDC, local flood control districts, NMFS, CDFW, CCC, NPS, local cities and counties	Funding and staff
NPS, State Parks, BLM, local land trusts	Installation of fencing and signage; enforcement. Local governments can plan for restrictions to public access in their LCPs.CCC would need to approve signage and LCP updates.

SWRCB, RWQCB, EPA, Army Corps of Engineers	Requires sediment/sand testing/approval by RWQCBs. CCC permit or federal consistency review.
CDFW OSPR, NOAA Restoration Office, NPS, USFWS, CCC	Collaboration of the responsible party with Federal, State of California, and tribal trustee agencies.Climate change modeling.
State Parks, USGS, TNC, local land trusts, counties and cities, academic institutions	Funding, staff, research to identify cliffs less susceptible to erosion.
California Conservation Corps, California Native Plant Society, Caltrans, land owners/managers (public and private)	Appropriate species that will persist in the context of future change, permits.
NPS, State Parks, land owners, National Audubon Society, California Conservation Corps, friends and stewards programs of the seashores and parks, Point Blue (use STRAW program's plant pallette modified for dunes/beaches), CCC (through permit conditions or LCPs), local governments	Create database of useful species to fill this niche (similar tool created for the Bayland Ecosystem Habitat Goals Update), source/supplier, staff and money, consider paleo/historic record to ID plants that thrived under previously similar conditions)
NPS, local governments	CCC permit or federal consistency review.
CCC in partnership with Sanctuary, CDFW, NPS, Coastal Conservancy, local governments in their LCP updates.	CCC review of LCP updates or other plans.

CDFW - for vessel-based impacts, BLM, NPS, or USFWS for land-based impacts, Sanctuary or NPS for air-based impacts. Partners include: State Parks, NPS, county and city parks, Marine Mammal Center, Sanctuary (Beach Watch), MARINe, universities, CCC permit conditions for signage.	Public education (staffing for education and enforcement and resources like ropes and signs, interpretive materials). Provide spotting scopes for people to see mammals/seabirds up close. Better coordination amongst organizations and agencies to report new haulout areas, changing uses, etc. Landscape design of observation points, most protective to mammals and best vantage point.
CCC, NPS, local cities and counties	
Sanctuary in partnership with National Aquatic Invasive Species Group, SF Estuary Partnership, SF Estuary Institute, and other relevant estuary management agencies (CDFW, NPS).	Need an understanding of what species may invade the area, monitoring and maintenance, collaboration on education and outreach - work with local community and other management agencies to mitigate introductions and enhance participation. CCC approval of permits and LCP updates.
Sanctuary and relevant species management agencies	Specific definition might want to be revised by local experts - may want to re-word and change from California Current designated in this strategy.
MARINe, CDFW (base off of existing protocols for community assessments), Sanctuary should lead the effort if it is determined a novel program is warranted. NPS.	Monitoring programs, volunteer removal programs; outreach to corporations, schools, communities to volunteer. Protocols for identifying invasive species as well as the response - trigger criteria to launch a rapid response. Permit for collection of novel identified organisms. Funding will be needed. Build capacity through citizen science training (e.g. LiMPETS).

Sanctuary, NPS, State Parks, land owners, National Audubon Society, California Conservation Corps, friends and stewards programs of the seashores and parks	Build and use volunteer base for manual projects. Will require monitoring and maintenace. Education and outreach with community, visitors, management agencies. Funding. CCC approval of permits and LCP updates.
NPS, State Parks, CalTrans, local counties	Training, funds, CCC approval of permits and LCP updates.
Local governments can plan for road relocation in their LCP updates. 1) A state agency should be identified to organize implementation in partnership with Caltrans, Sanctuary, CCC, County of Marin, and NPS. 2) County of Marin, Sanctuary, NPS 3) Caltrans, San Mateo County, CCC, State Parks, scientists 4) NPS and San Mateo County, CCC, USCG (need facility access), private ranching community, farm bureau 5) San Mateo County, NMFS, CDFW, Pescadero Fire Station (currently working on moving their flood-vulnerable facility) 6) Caltrans, City of Half Moon Bay, CCC 7) Caltrans, Sonoma County, CCC 8) Caltrans, City of San Francisco, CCC 9) Caltrans, Marin County, CCC	1) Do not anticipate the need for policy change in order to implement. Post-disaster planning might need to interface with local hazard mitigation plans. 2) Likely requires permit and environmental impact review; Needs project coordinator and adequate resources for assessments; Funding; Do not anticipate the need for policy change in order to implement. CCC approval of the plan, especially if elements are in the LCP update. 3) Need a place to move Hwy 1 5) Funding: partners can help leverage funding

Caltrans, Sanctuary, Army Corps of Engineers, RWQCB, GGNRA, land owners	Capitalize on natural destruction events, rebuild smarter. CalTrans would likley need policy adjustments (repair vs. rebuild); develop pre-planned response to road failures; revise planning horizons. CCC approval of a plan.
Sanctuary, NOAA Restoration Office, USGS	Excellent marine geomorphologists, oceanographers, CCC federal consistency review.
CCC, local cities and counties, land owners	
State Parks, Land Trusts, local cities and counties	Funding and staff
CCC, Coastal Conservancy, local cities and counties, Center for Ocean Solutions (policy guidance), Georgetown Law Center, State Attorney General (legal guidance), UCLA Model Ordinance project (policy guidance)	Education and outreach: make changes ammenable/understandable by the public. If needed, explore and investigate opportunities for how exclusion has been accomplished elsewhere (e.g., along the Napa River, other floodplain examples), and confer with groups with expertise in this realm (e.g., Nature Conservancy, Coastal Conservancy). Capitalize on large natural distasters - prevent vulnerable re-building that would negatively affect estuary migration.
CCC, local cities, counties and land trusts, Coastal Conservancy, land owners, State Parks, NPS, State Lands, BLM, TNC, Caltrans, FEMA (through Hazard Mitigation Plans), Army Corps of Engineers	Spatial prioritization, funding, knowledge of sediment circulation and supply
Relevant utilities agencies and/or project lead of other barrier removal projects, local cities and counties.	Planning for infrastructure relocation can be part of a local government's LCP update.
CCC, local cities and counties	

CCC, State Lands, local cities and counties	
CCC, local cities and counties	
Caltrans, City of Half Moon Bay, CCC, Marin County, homeowner's associations (if applicable), NPS.	Caltrans staff and time, funding (increase gas tax in San Mateo County), create sustainable development community with transit hub
NPS, State Parks, CCC, local cities and counties	Funds, permits, staff time
NOAA (it might be possible for NOAA to use a rolling tidal epoch), State Legislature, Federal Supreme Court, State Lands, CCC	Lobbying capabilities for legislative actions
NOAA, State Lands, CCC, State Legislature	Lobbying capabilities for legislative actions

Sanctuary to convene a regional partnership of numerous land management agencies, scientists and funders. See "required resources" for a listing of partners that need to be involved. .	Funding: variety of sources/joint venture (NOAA, NPS, Stanford Natural Capital Project, Universities/Academics, Federal Highways, foundations) Modeling: leverage current data from existing regional efforts and combine with new modeling. Will need someone to lead data aggregation, plus someone to model (consider Point Blue and/or USGS) Data/models that should be used: - current estuary inventories from various management agencies/groups; combine these to make a regional inventory, and standardize/expand on detail collected for each estuary (e.g., key species, services provided, estuary values, etc.) - OCOF: use to identify what areas will be flooded; combine with salt water intrusion modeling, riverine flooding modeling (e.g., FEMA flood maps). Build in uncertainty by using max/worst case scenario projections - pollutant hotspots (critical to know if polluted area will be innundated; get data from EPA and regional/local environmental health agencies) - historic/archeological resources (NPS, State parks, counties) - sediment availability (identify if each estuary requires more/less sediment) - location of berms/levees/existing infrastructure/armoring - demonstration projects/lessons learned from regional projects (e.g., Muir Beach, Giacomini, South Bay Salt Ponds) Can create a decision matrix to go along with this process to facilitate future updates/repetitions.
Sanctuary, CDFW and OST. Relevant land owners (e.g. NPS) to lead monitoring on individual sites.	May require a Sanctuary staff member to lead data management and acquisition. Need rapid response monitoring teams ready to deploy (in case of extreme events). Need a standardized monitoring framework across sites; need to identify what Sanctuary wants to monitor for. Base locations on sites identified through monitoring and inventory action. Gather input from other groups (Bay Area Climate Change Consortium, CA LCC, agency partners). There are several estuaries that contain MPAs so it would be good to link the MPA monitoring efforts to other monitoring efforts for estuaries in the region.
Sanctuary, Coastal Conservancy (for funding), academic institutions, NPS, USGS, Army Corps of Engineers, Coastal Sediment Management Workgroup	Researchers, funding

USGS, universities.	Modeling, interagency collaboration of Federal, State, County, and municipal governments; regional planning - perhaps along the lines of planning zones used in Area Contingency Plans; Army Corps of Engineers might have very useful expertise
USFWS, Sanctuary, NPS, State Parks, relevant land managers	California Coastal Commission permitting
SFPUC or Public Works, CCC for review of permit or LCP updates.	Funding for infrastructure improvements and/or replacements
Local cities and counties, SWRCB, CCC	Hydrology information, funding for contracts to regrade/swales/etc, local permits
RWQCB, SWRCB, California Farm Bureau, Natural Resources Conservation Service.	Local Resource Conservation Districts. Sanctuary to help track water quality changes through monitoring (ACCESS cruises) with partners (Point Blue).
For all potential projects: SWRCB and RWQCBs, local cities and counties, relevenat forestry, farming, mining, logging operations upstream. Additional: 2) Gualala River Watershed Council, Friends of Gualala River 3) Russian River Watershed Association, Russian River Watershed Protection Committee	Collaboration among rocky intertidal managers (BLM, CDFW, State Parks, Sanctuary) and RWQCBs. Need to secure immobilization of pollutants as the distrubance regimes along coastlines, coastal rivers and streams, and uplands intensify. CCC review of plans.

Local cities and counties, Friends of the Urban Forest, California Conservation Corps, The Arbor Day Foundation, CCC (in permit conditions or LCPs), ASBS funding	Wetland vegetation, saplings, staff or volunteers
Resource Conservation Districts, SWRCB, CCC (in permit conditions or LCPs)	Grants and conservation easements for private landowners
Sanctuary and landowners (NPS, CDFW, State Parks) in partnership with NGOs to get funding	Marine and coastal habitat restoration ecologists; monitoring to address efficacy. CCC permit or federal consistency review.
Sanctuary in partnership with NPS, Bodega Marine Lab and UCSC. NGOs and Coastal Conservancy for funding.	Monitoring to address efficacy. CCC permit or federal consistency review.
Sanctuary in partnership with Coastal Conservancy, CDFW, NPS, other agencies that manage marine resources, and NGOs to assist with funding	CCC permit or federal consistency review.
USFWS, Point Blue, State Parks, CDFW, NMFS, NPS, relevant coastal land owners and managers	Determine need for seal pup thermal protection; California Coastal Commission permitting

Partnership with land owners, County (equipment/staff), Sanctuary, regulatory agencies, Coastal Commission, community support. Lead agency may be different if species of concern isn't a key commercial or T/E species, or depending on who wants the action done	Need to first accomplish in the near-term the policy/permitting framework (programmatic permits required for each system; must be very site-specific and lay groundwork for approval ahead of time) and a better understanding of individual system dynamics to identify when this management action would be beneficial/harmful. Will also require agency coordination (esp. related to breach timing). Funding needed to monitor impacts and cover permit costs.
Army Corps of Engineers in partnership with Coastal Sediment Management Working Group, CA State Sediment Master Plan, other sediment management and planning efforts. Coordination with SWRCBs for TMDLs. NPS.	Expand existing groups/efforts to look at estuaries. Utilize existing monitoring data from NPS, USGS, and gather high resolution data for sites of interest.
Sanctuary, NPS	Requires funding, enforcement to protect current beds from degredation and to protect restored areas, and eduation and outreach. CCC permit or federal consistency review.
Sanctuary	Permitting
USFWS, CDFW, CCC, Sanctuary, land owners	permitting, money, staff, engineer studies

City of San Francisco, Army Corps of Engineers, NPS, State Parks, USFWS, SPUR, USGS, SFPUC, CCC, Sanctuary, local harbor districts, cities, and counties, Coastal Sediment Management Workgroup	Sand, money, staff, federal permit, CCC permit or federal consistency review.
Army Corps of Engineers, CCC, State Lands, Sanctuary, landowners/managers	Spatial assessment, feasibility and efficacy studies, permits.
NPS, TNC, local counties and land trusts, private land owners	Agreement with ranchers, resource conservation districts
Army Corps of Engineers, BLM, Resource Conservation District, Bureau of Reclamation, DWR, Coastal Commission, watershed organizations and water districts, partnerships with dam managers.	Funding, support from upstream/downstream communities, will require impact studies
Local counties, ranches, Resource Conservation District, NMFS (salmonids), CDFW (fairy shrimp)	Planning, coordination, and knowledge: channelization has been done at Giacomini - could use similar resources. CCC permit or federal consistency review.
CCC and local counties and cities, academic institutions, Army Corps of Engineers	Resources to identify best design to use for armoring, working with CCC to allow for different armoring materials and designs. Working with local universities on engineering.
State Parks, NPS, State and County Departments of Public Health, volunteer groups (such as Save Our Shores, Pacifica Beach Coalition)	Organize volunteers for beach clean-ups, funding.

State Parks, NPS, BLM, County Parks, Municipal Parks	Increased signage and enforcement, CCC permit or federal consistency review.
State Parks, NPS, BLM, County Parks, Municipal Parks, CCC (permit conditions or LCPs)	Funding, staffing, create reservation system, signage, outreach, enforcment, CCC permit or federal consistency review.
CCC, local cities and counties	
Agencies that own or abut land, land owners, NPS, Army Corps of Engineers, local cities, counties and land trusts, Resource Conservation Districts	Funding via joint venture with many groups, maybe insurance companies. Will need tradeable land. Policy changes may be required (e.g., congressional change to allow trading of NPS lands). Education and outreach will be critical to gain public support; utilize regional modeling to show current land owners why moving is the smartest financial decision. If needed, explore and investigate opportunities for how this has been accomplished elsewhere and confer with groups with expertise in this realm. Golden Gate and Point Reyes (NPS) have already aquired estuary-adjacent parcels that have come up for sale (NPS has a lands acquisition program).
CCC, local cities, counties and land trusts, Local Coastal Programs, Coastal Conservancy	Part of already existing processes
CCC, local cities and counties	
CCC, local cities and counties	Could be accomplished with a state level statute
Sanctuary, academic institutions, oyster companies	Knowledge: look at case studies from San Diego area, east coast and Gulf coast, San Francisco Bay research, Drakes Estero research to document recovery by CDFW.
Sanctuary (support from CDFW, State Parks, NPS, BLM, local counties)	Sea Grant funding to research institutions, CCC approval and permits for test plots.

CDFW in partnership with researchers and OST.	
USFWS, NMFS, USCG, Sanctuary, NPS, State Parks, County Parks, CDFW, Boating and Waterways	California Coastal Commission permitting
Marine Mammal Center, Seabird Protection Network, NOAA MMPA , USFWS, USGS Western Ecological Research Center, MBARI, Point Blue, NPS.	
CDFW, State Parks and County Parks, NPS.	Increased monitoring of harvested OA-sensitive species (mussels, abalone) with triggers or thresholds. Increased funds for CDFW wardens and Parks Rangers to patrol and check permits. Requires public education and cooperation – outreach and stewardship. Monitoring teams to detect effectiveness of regulations (tie-in with Ocean Science and Marine Reserve System monitoring)
Caltrans, local cities and counties, Flood control districts, FEMA, California Office of Emergency Services, CCC (in permit conditions or LCPs), NPS	flood maps, money, community will
Land owners in partnership with Land Acquisition Funds, National Audubon Society, NPS	Identify transitional wetland habitat using regional estuary modeling and inventories, and obtain land by coordinating with land acquisition action. CCC permit or federal consistency review.

Notes	Habitat(s)
Creates/maintains habitat area and function in the face of sea level rise. Potential issues with TMDLs.	estuaries
There are many unknowns in how to manage for estuaries; this action will test different strategies and help innovate management, with the goal of helping sustain estuary habitat. Could have negative impacts (e.g., loss of tidal mudflat habitat). Need to balance risks	estuaries
Reduces erosion (problem for Bolinas Lagoon), creates habitat for estuary movement. May be perceived by the community as a loss of flood protection.	estuaries
	beaches/dunes

May alter habitat in upland areas. Could cause stream vs. estuary conflicts. Land owner/infrastructure challenges. Helps trap sediment/paces sediment release, enhancing estuary function. Enhances wetland filtering characteristics. Supports water infiltration and percolation. May benefit freshwater wetlands. Can help mitigate marine debris associated with storms.	estuaries
For distance sources of sediment, this action also requires watershed management efforts to reduce devastating impacts of wildfires that remove extensive vegetation and result in debris flows that are more likely and larger.	rocky intertidal
Consider the balance of human water supply (agriculture and residential) vs. ecosystem needs. Sediment supply/transport may increase; which may not benefit sediment-heavy estuaries. Moderating temperature may help mitigate algal blooms.	estuaries

Effect on public access, public opinion. Opportunities for environmental education. Could link to Marin and San Mateo Counties YESS program and other school curricula	all
The Pillar Point jetty is causing the erosion of surfer's beach, but the negative consequences of removing this structure may be too great for the community (in which case, managed retreat and beach nourishment should be implemented). This strategy protects and encourages expansion of sandy beach habitat, restores sediment influx, protects dune systems and infrastructure inland of beach, enhances recreational value, improves public access, prevents the impact of flooded infrastructure to natural system, reduces further risk of erosion adjacent to the problem erosion areas, and allows coastal systems to respond naturally. This strategy may also result in changes to shoreline erosion, e.g. accelerate where shoreline is currently protected and decreased where currently accelerated.	beaches/dunes
	all
	cliffs

	beaches/dunes
This recommendation is applicable to all habitats and affected areas.	all
	cliffs
	cliffs
	beaches/dunes
Impacts to recreation and visitor facilities through managed retreat and dune/wetland restoration. Shoreline recreation may be preserved but facilities may require relocation to offsite with shuttle to access beach. Would provide added protection to the town of Stinson Beach from SLR.	beaches/dunes
	cliffs
Effect on public access, public opinion. Species populations might continue to improve under additional protections against human disturbance.	rocky intertidal

SLR and storminess will flood haul out locations, especially during pupping season which overlaps with upwelling season – this may cause concentration of haul outs to fewer locations (erosion of north-facing beaches). Species conservation planning for marine mammals. Safety of boaters and pilots need to be considered.	all
LCP policies and permit conditions are potential ways to implement this management action	beaches/dunes
This action specifically prevents establishment (as compared to removing invasives that are already established)	estuaries
	all
Check with Pete Raimondi on existing efforts (biodiversity plots) and consider altering this recommendation for better continuity and support.	all

Rare plants and snowy plovers may benefit, but need to mitigate for increased depredation of plover chicks. Likely to require herbicide use. Where European beachgrass and iceplant are pervasive, removal cannot be accomplished and sustained by volunteers or heavy equipment. May mitigate range expansions with warmer water. Helps restore sediment and hydrological movement. Volunteer engagement can enhance education/outreach efforts. Disturbance associated with removal could create habitat/opportunity for other invasives.	all
Similar to actions for strategy 15 "Stabilize cliffs through revegetation"	cliffs
Creates space and facilitates estuary movement in response to SLR, reducing vulnerability to flooding. Facilitates water and sediment movement throughout the estuary, improving hydrologic function. Improves connectivity between upland and lagoon habitats, with positive impacts on riparian and nursery habitat. Site specific benefits and consequences: 1) Provides more areas for eelgrass restoration in Tomales Bay. Reduces flood risks for human communities and infrastructure, enhancing long-term resilience. Also improves driver safety and traffic flow. Potential conflicts with tourism, transportation, infrastructure needs, etc. Road redesign may be the only feasible alternative since it is Highway 1. May need a causeway or reroute over the hills to the east at various locations. 2) Provides transitional habitat in an estuary where most of the edges are hardened. Road removal may cause loss of non-native and native species in habitat on other side of the road with unintended consequences; however, this area will eventually be inundated anyway. Transportation conflicts: local residents, tourists. Part of Marin County's sea level rise project - this action supports local efforts. 3) May improve dynamism of marsh morphology - Hwy 1 has low point near marsh, estuary bar is fixed under Hwy 1 bridge and can't move around, which likely affects marsh morphology. However, no records show the historical outlet so it is unknown how marsh morphology may change. Societal impacts of moving road: directing it toward a small town, tourism/recreation, safety routes, etc. Could negatively impact marsh depending on design. 4) This road (culvert/bridge) is at the pinch point at the head of Drakes Estero, and floods every winter. Would allow connectivity of habitats on each side of road, and prevent costly infrastructure maintenance. May be able to link to county program: San Mateo is identifying all roads vulnerable to SLR and affected by flooding. There are communities on each side of road; may affect access. 5) Road is at head of marsh and floods frequently because channel is filled with sediment. Could provide additional wetland habitat. County is moving fire station (Pescadero Fire Station Replacement Project) and looking at options for the road. There is an opportunity to leverage projects for multiple benefits.	all

Creates functional habitat and space in areas that can't be moved/expanded. Short-term impacts to existing species/vegetation with habitat modification (e.g., may need to fill part of lagoon to create sloped transitional habitat).	estuaries
May require efforts to clean up contamination sites, remove infrastructure at risk to provide adequate setbacks for development of new habitat - would link to efforts to control or manage coastal cliff erosion; intersects with intertidal species conservation strategies.	rocky intertidal
LCP policies and permit conditions are potential ways to implement this management action	beaches/dunes
	cliffs
Prevents construction/retrofits that can impede estuary migration. Prevents building construction that could fall into estuary habitat in the future. Public opinion may be hard to change. In long-term, benefits counties, cities, and homeowners: saves money by preventing the construction of structures vulnerable to SLR and flooding.	estuaries
Might be in conflict with adjacent land management that is trying to abate SLR	beaches/dunes
Deals with mulitple obstructions at same time (co-benefits, leverage projects); facilitates estuary expansion. Availability of utility services	estuaries
LCP policies and permit conditions are potential ways to implement this management action	beaches/dunes

LCP policies and permit conditions are potential ways to implement this management action	beaches/dunes
LCP updates are a way to implement this policy.	beaches/dunes
	beaches/dunes
	beaches/dunes
Communicate importance to local and state-level legislators; NOAA or the State Legislature would need to implement the policy change	beaches/dunes
Communicate importance to local and state-level legislators	beaches/dunes

Identifies how estuaries may change, and areas ripe for estuary expansion. Can be used to inform locations of all other adaptation actions, and helps prioritize sites for action. Short-term benefits: can identify where short-term measures are needed/feasible and identify opportunities to leverage resources with other groups and activities. Long-term benefits: guides prioritization of projects, can identify short-term actions within longer-term processes.	estuaries
Can help inform adaptive management and help mitigate negative impacts of extreme events in the future by better undestanding natural processes. Builds knowledge to inform adaptive management. Can be used to increase education/outreach and public engagement.	estuaries
Implications for estuary management and cliff erosion. Possible counteracting sources (e.g. cliff erosion and long-shore current counteract).	beaches/dunes

This strategy informs the implementation of strategies 21 and 30. This activity intersects with intertidal species conservation strategies.	rocky intertidal
	beaches/dunes
Improves water quality	beaches/dunes
	cliffs
Decrease the possibility of negative impacts due to blooms smothering the intertidal (macro) and changing water quality (micro). Planning to reduce debris flows from storms, efforts to reduce mercury input into coastal waters	rocky intertidal
Negative impact on sediment-starved estuaries. Note that San Francisco Bay and Tomales Bay have TMDLs for mercury.	rocky intertidal

Improves water quality, and reduces beach erosion	beaches/dunes
Improves water quality	beaches/dunes
Facilitates species colonization and recovery from disturbance due to an increase in ocean wave energy that may destabilize and transform intertidal habitats.	rocky intertidal
Reduces ocean wave energy in subtidal habitats as a further step to reduce energy impacts in the intertidal zone - to modulate the intensity, frequency, and duration of storm impacts. Reduces sediment and turbidity in the intertidal. Creates habitat for subtidal systems that supports objectives for rocky intertidal ecosystems. Need to balance with any commercial programs for kelp collection. Learn from Southern California efforts. Seek funding for a research project at Bodega Marine Lab.	rocky intertidal
Additional benefit is carbon sequestration and local mitigation of the impacts of ocean acidification provided by surfgrass restoration.	rocky intertidal
Make out of solar fabric for ancillary power production (e.g. fans if needed). Create possible user experience/education tie-in, such as renting similar umbrellas to beach users.	all

Creating a breach may ameliorate stagnant water impacts, poor water quality, limited passage (anadromous fish [juveniles/adults], recreation, other biota) and promote hydrologic and sediment transport. May cause earlier opening in the future, and could affect marsh accretion and water chemistry (methyl mercury production). May provide positive education opportunity around resource values, and may benefit certain human communities that believe the septic system doesn't function when estuary is closed. May also help prevent algal blooms by moderating temperature. Closing the bar may capture freshwater and protect/maintain related freshwater habitats, including nursery grounds, when runoff is pulsed. May reduce recreational use/access and/or become stagnant and smelly. Could cause loss of sediment (depending on how it's done), shorebird foraging habitat/subtidal habitat, haulouts, cordgrass, and mud organisms (due to anaerobic conditions).	estuaries
Could benefit beach systems. Enhancing sediment delivery may not be possible if streams harbor sensitive species (e.g., salmonids).	estuaries
Enhances nursery grounds. May help regional carbon sequestration. Economic benefits (oyster farming). Need to work with oyster companies to reduce light blockage and other damage from anchors, racks, floats.	estuaries
Potential impacts to the intertidal area due to trampling and harvest - needs to be done in a way that does not impact resources (consider only free-floating harvest by vessel). Separate approach (Water Quality Management strategy) focuses on reducing pollutants from estuaries and run-off.	rocky intertidal
Devil's Slide did this for Common Murres, possible lessons from Santa Cruz with physical and biological tools. Improves public access when required by code. Protect public safety. Requires maintenance.	cliffs

Implications for beach and benthic invertebrates. Forestalls beach hardening to maintain habitat. Potential to establish dune vegetation. Carbon emissions from implementation may be significant. Impact to surfing uncertain. Consider where sediment source is blocked by dam or otherwise. Apply for both human and wildlife access. Preserves/prolongs beach habitat values, as well as public recreation and access.	beaches/dunes
Wave energy generation. Artificial habitat created on structures.	beaches/dunes
	cliffs
Restores natural sediment regimes to help with accretion; helps hydrology and water movement; promotes healthy function; improves beach access; possible trade-off in current discharge rates; possible tie-in to salmon access. Potential negative impacts of dam removal: shifts in open water habitat, water supply and storage, hydrological regime (increased water and uncontrolled flooding), contaminant loads, upstream habitat, recreational access, change in timing of availability of water.	beaches/dunes and estuaries
Pollutant mobilization (e.g., mercury - Walker Creek), short-term impacts to existing species/vegetation with habitat modification. May moderate temperature which may help mitigate algal blooms.	estuaries
Potential interactions with nearby beaches with sediment movement based on oceanographic conditions. The littoral zone – doing work on sediment movement in San Mateo/SC counties.	rocky intertidal
	rocky intertidal
Build new infrastructure (e.g. bathrooms) to accomodate more visitors. Increase schedule of litter clean up.	beaches/dunes

	beaches/dunes
Seasonal closures may be more effective and efficient.	beaches/dunes
LCP policies and permit conditions are potential ways to implement this management action	beaches/dunes
Removes structures that are going to be destroyed by flooding and/or structures that could fall into the Sanctuary. Provides habitat/room for estuaries to expand. Land trading may affect other terrestrial habitats (i.e., may allow for construction in new areas). Can combine with removing non-functional infrastructure (e.g., elimnate old berms and flood levees). Will likely face public opposition, but there are long-term benefits to human community: structures will eventually be destroyed by flooding, cheaper to move the infrastructure now.	estuaries
	beaches/dunes
LCP policies and permit conditions are potential ways to implement this management action	beaches/dunes
	beaches/dunes
Helps inform eelgrass restoration efforts, which enhances estuary habitat, and may enhance regional carbon sequestration efforts . Economic benefits (oyster farming)	estuaries
Strategy would likely stabilize species populations, and facilitate habitat creation for new assemblages of intertidal communities whose species are shifting their range as the result of climate change impacts.	rocky intertidal

Strategy would address decreased larval density due to increased turbulence of the water column (reduced survival) and increased offshore advection of larvae due to increased wind.	rocky intertidal
Possible benefit - wave energy generation	beaches/dunes
	beaches/dunes
Would provide greater benefit to rocky intertidal community by increasing/maintaining biomass of species and surface roughness (maintaining functional habitat).	rocky intertidal
Sediment deposition, salmon habitat impacts from flood control actions.	beaches/dunes
Tradeoff with existing habitat: may require some modifcations. May restrict grazing opportunities. Provides habitat for the threatened and endemic red-legged frog. Creates refuge habitat from temperature and high water events.	estuaries

Priority
Priority
Priority
Priority
Priority

Priority

Priority

Priority

Priority
Priority
Priority
Priority

Priority
Priority
Priority
Priority
Priority
Priority
Priority
Priority

Priority
Priority
Priority
Priority
Priority

Priority
Priority
Priority

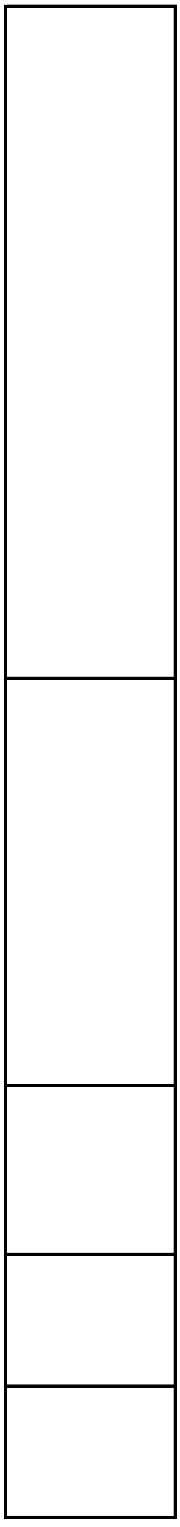
Priority
Priority
Priority
Priority
Priority
Priority
Priority
Priority

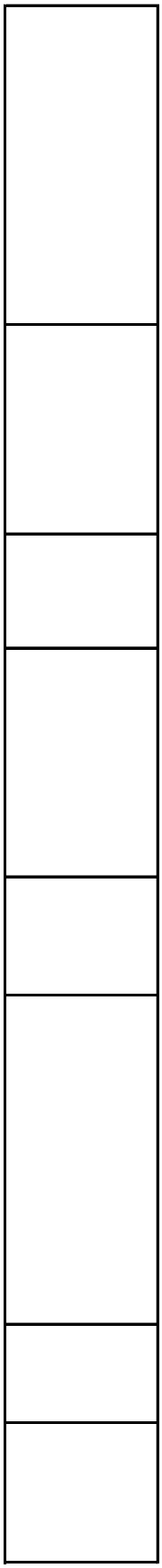
Priority
Priority
Priority
Priority
Priority
Priority

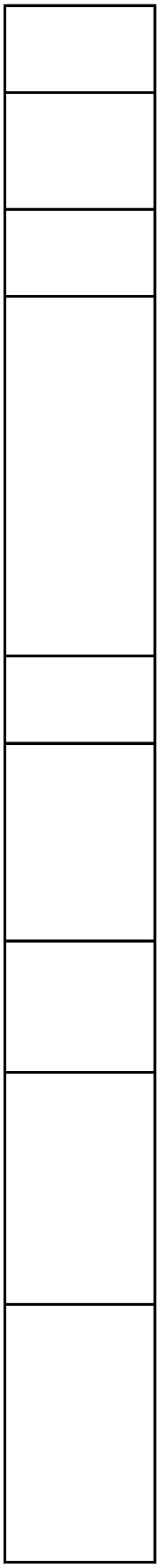
Priority
Priority
Priority

Priority
Priority
Priority
Priority
Priority
Priority

Priority
Priority







Priority